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AESTHETIC UNITY

AN INVESTIGATION INTO THE CONDITIONS THAT FAVOR THE APPERCEPTION OF A MANIFOLD AS A UNIT¹

By MARGARET OTIS

The principle of 'unity' is fundamental for any theory of aesthetics, for the harmonious union of the many in the one is necessarily involved in all aesthetic experience. The treatment of the aesthetic experience as an independent and fundamental life value is found presented by Münsterberg,² who places the inner agreement of meaning in the manifold as essential for the beautiful object. Aesthetic unity as thus understood is the subject of the present investigation, for it is a study of the inner agreement and disagreement of the various factors that go to make a work of art.

As a problem in experimental psychology the perceptive process is the one immediately concerned. In all our conscious experience we are constantly unifying various elements into wholes. Given a mass of lines, dots, or material of any kind, a selective process occurs and out of the mass groups are formed, the "higher units"³ of perception. The dot figure of McDougall⁴ well illustrates this process, also the lines and squares used by F. Schumann⁵ in his investigation of the process of visual perception. The problem of the attention is involved as in the interpretation of equivocal figures and puzzle pictures, for example, the six-pointed star of James⁶ that may be perceived as two superposed triangles, or as a hexagon with six small triangles, one attached to each side. Titchener⁷ refers to cases of puzzle pictures in discussing his theory of the two levels of attention.

¹ The problem was suggested by the late Professor Münsterberg and was conducted in the Harvard Psychological Laboratory during the academic year 1909-1910. There were 7 subjects all of whom were either instructors or graduate students of psychology.

² H. Münsterberg: *Eternal Values*, 1909, chs. 9, 10.

³ Cf. Ladd and Woodworth: *Physiological Psychology*, 1911, p. 597.

⁴ McDougall: *Mind*, 1902, N. S. XI, 316.

⁵ Schumann: *Beiträge zur Analyse der Gesichtswahrnehmungen*, *Zeitschrift für Psych.*, XXIII, p. 1.

⁶ James: *Principles of Psychology*, I, 1890, p. 443.

⁷ Titchener: *Psychology of Feeling and Attention*, 1908, p. 228.

Material of like character has been collected by various workers,

The method used in the present experiment depends largely for its effectiveness on just such possibility of a double interpretation of the figures concerned. A manifold is given from which the mind may select and interpret just as in the case of the equivocal figures. The manifold in this case consists of a number, usually six, small objects cut from cardboard. (Plate I, figs. 1-13.) These are arranged in various positions and combinations, and various possibilities of interpretation occur.

In regard to the relative merit of various figures such as the circle, the square, triangle, etc., some information has already been obtained. Fechner⁸ finds that the degree of unit that joins the parts of a circle is higher than that which joins the parts of a straight line and that unity between the parts of an ellipse is higher than that of the circle. Puffer⁹ discusses the forms found in use in the composition of pictures; pyramidal, diamond shape, diagonal, V shaped landscapes and square. She finds that the pyramidal is the commonest and the square less frequent. Gordon¹⁰ speaks of the triangle as the simplest of enclosed forms, the square as less concentrated, and the circle as the symbol of completeness. Some of the results of the present investigation have a distinct bearing on this question, the triangle and circle proving to be the best forms to be felt as units, in tests of varying character.

Such results are important for Aesthetics, yet our main problem has to do with the question of unity alone. The question of the pleasure derived from unity does not enter in. The subjects in the experiment were instructed to give a judgment merely as to whether a unit was apperceived or not, and the feeling, pleasurable or otherwise, though noted at times, was in no way the object of study.

Thus the purpose at hand is to study the process involved in the act of the mind by which a number of elements are unified into a whole, to ascertain what conditions favor and what hinder the formation of units, to investigate the power of various factors involved and to test their relative importance. This brings us to a description of the experiment itself.

The material used consisted of small objects cut out of cardboard in various shapes (Plate I, fig. 1-13). These are reproduced slightly reduced (one sixth) from actual size used.

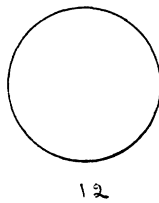
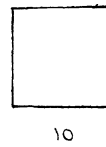
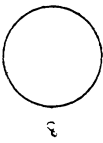
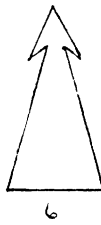
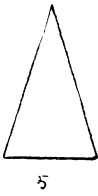
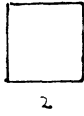
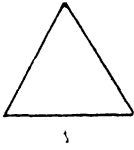
notably: Von Bezolt, *The Theory of Color*, p. 253, Wallace Wallin, *Optical Illusions of Reversible Perspective*, Mach. *Analyse der Empfindungen*, p. 164, Witmer, *Analytical Psychology*, p. 12 sq.

⁸ G. T. Fechner: *Vorschule der Aesthetik*, 1876, p. 53.

⁹ E. Puffer: *Psychology of Beauty*, 1905, p. 138 sq.

¹⁰ K. Gordon: *Aesthetics*, 1909, p. 166 sq.

PLATE I.



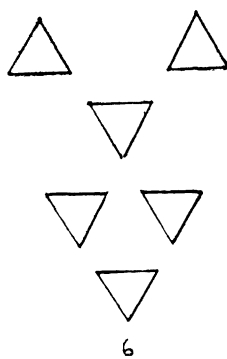
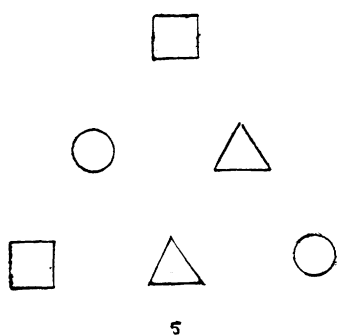
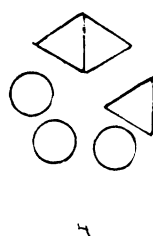
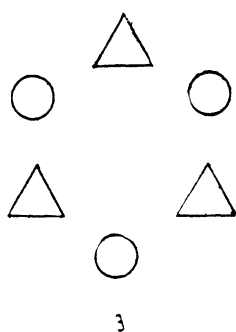
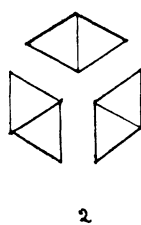
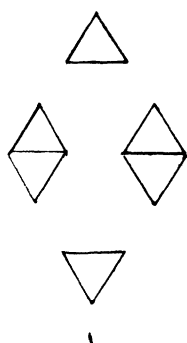
These objects, usually six in number, in some cases nine, were arranged on a black background in various figures within an area about 20 cm. square. (Cf. Plate II.) These figures were exposed by means of a tachistoscopic apparatus arranged as follows: The subject was seated before a black cardboard screen into which was fitted a diaphragm shutter with opening 3 cm. in diameter. On the other side of the screen was a cardboard surface also black, slightly inclined to the horizontal, and arranged to be in the field of view as seen by the subject, who had his eye at the opening of the shutter. The small pieces of cardboard were arranged on this surface. The figures were given an exposure of one-fifth to one-half second and the subject was asked to report in what way he apperceived the objects; whether they were united into a whole, or into subordinate groups, or whether they remained a manifold. The answer was recorded and the objects were rearranged. About thirty such exposures were given at one sitting, the arrangements of the objects being such as to throw light on some especial part of the problem. The objects used at first were white; later color was added, and in some of the final tests grey was used. The colors used were kept the same throughout, being red, green, blue, yellow, violet, orange, of the standard colors as given in the catalogue of Bradley. In one case only, two different shades of green, red, and violet were used. The time used was kept constant as far as possible. The shortest exposure was used at first for white objects on a black background. When objects of different shapes and colors were used, it was found necessary to give a longer exposure, and for the case where nine objects were used in relatively complicated figures a long exposure was needed. The influence of the time element, however, was considered only incidentally. In one case, only, the same figures were repeated using a longer time exposure. The object was to give sufficient time for the subject to be able to perceive the figure clearly, but not enough to allow him to study it, for it was desired to have merely the first impression recorded.

A unit as here used means not merely that the objects are felt as a whole simply because in the same field (the subjects were cautioned especially in this regard), but the individual parts must be felt as bound together, as belonging together in some way.

The factors investigated that have influence in the unit-making process are the following:

1. *Position.* The position or arrangement of the elements

PLATE II.



may give the character of unity to the group, such as a symmetrical arrangement, arrangement in a geometrical form as a circle or a triangle, arrangement in lines, or it may be that mere contiguity may give unity.

2. *Form*. Like forms such as triangles or circles may be grouped together.

3. *Color*. Like colors may be grouped together to form a unit.

4. *Direction*. Like direction has the power to make a unit, and certainly the direction in which the parts point has at all times a powerful influence, even if it is not the predominant one.

5. *Size*. The size of the elements is found to be important in its influence on the grouping.

6. *Association*. The binding principle may be association with some idea already in the mind.

Some of the terms used in the course of the experiment need to be defined as to their exact application, and are as follows:

The term *unit* is used when reference is made to a whole formed of all the elements present in the field. The term *figure* is used when reference is made to the arrangement of the elements used. The term *group* is used when some of the elements form the whole, the others being neglected or going to form another group. Thus six objects might form three groups composed of two each. The term *manifold* is used when the objects in the field are seen as individuals and are not grouped.

Groups may be formed determined by various factors mentioned above. Thus *color group* refers to a group determined by color. *Form group* refers to a group determined by the form of the component parts. A *position group* is determined by the arrangement of its elements. Similarly the terms *direction group* and *size group* are used when direction and size respectively are the predominant factors that determine the group.

It often occurs that the subject can report more than one experience upon looking at the figure exposed, that is, he may see it in one way first, and then another interpretation will flash upon his consciousness. A unit may be his first experience, and then the figure will appear to be split into groups. All such experiences have been recorded. In calculating the results and making up the tables the numbers refer to the first experiences, yet it often happens that a consideration of the

second experience is helpful. In some cases certain ways of interpreting the figures will occur only as second experiences. If a unit is reported as first experience by four subjects and as second by three, it would show that the unity of the figure was felt by all, though in a less degree by some.

Form. The first experiment consisted in using six equilateral triangles, white on a black background, arranged in various figures. The objects at first were all the same shape. The next step was to study the effect of using objects of two different shapes, three triangles and three circles; and later a greater diversity of parts was used, two triangles, two circles and two squares. See Plates I and II. The figures in which the objects were arranged were, first, a circle, then a triangle, a diamond, a rectangle, a figure called for convenience a divided hexagon, and a figure something like an arrowhead. Each figure was repeated five times, each time with a different combination of its elements, the first exposure showing all like parts, the second two different shapes, the third greater diversity in the elements and so on to the fifth exposure. The results are tabulated in Table I. The exposures are numbered one to five. The numbers under the words *unit*, *group*, and *manifold* show the number of times the figure was judged to be the unit, group or manifold respectively. The answers as tabulated show a decrease in unity when unlike forms are used as elements of the figure. The judgment would often be that the figure was a poor unit, so the distinction is made in the table between a good and a poor unit.

From these results it appears clearly that the effect of introducing different shapes as elements in the figures is to lessen the unity and at times to break it completely. The total number of cases of a good unity for all the figures when like forms are used is 28 out of a possible 42; that is, 66%, while in case of the same figure under like conditions except that unlike forms are used, the number of cases of good unity is only 18 out of a possible 168, or 10%.

We can also study in this series the comparative excellence as units of the figures used. Referring again to the table, we see that the triangle is a unit 32 times out of a possible 35, the circle 30 times, the diamond 21 times, the divided hexagon 16, while the arrowhead is a unit only 14 times, and the rectangle only 9 times. Of these figures with this time of exposure we can say that the triangle is the best unit, the circle next, both possessing a high degree of unity, the diamond comes not far behind, while the divided hexagon proves to be not so

good a unit because of the tendency to apperceive it as three groups. The arrowhead figure proves a poor unit, and the poorest unit is the rectangle.

TABLE I

Exposure <i>Circle</i>					Exposure <i>Triangle</i>				
	Unit Good Poor		Groups	Mani- fold		Unit Good Poor		Groups	Mani- fold
1	7				1	6	1		
2	2	5			2		7		
3	2	3		2	3		5	2	
4	1	5		1	4		7		
5	1	4		2	5		6		1
	30		5			32		3	
<i>Diamond</i>					<i>Rectangle</i>				
1	6	1			1	2		2	3
2		3	4		2	1	1		5
3	1	2	4		3	1	1	5	
4		4	3		4	2		1	4
5		4	3		5	1		1	5
	21		14			9		26	
<i>Divided Hexagon</i>					<i>Arrowhead</i>				
1	6		1		1	1	3		3
2	3	3	1		2	1	3	1	2
3	1	1	1	4	3		2		5
4		2	5		4	1	2		4
5			6	1	5		1		6
	16		19			14		21	

Color. For the purpose of studying the effect of color six square objects were used of three different colors, two of each, in various combinations. These squares were arranged

to form the following figures: circle, cross, rectangle, a pyramid-shaped figure, triangle with apex below, and a monument-like shape with the parts contiguous. All possible combinations of the three colors were used. In general, color is found to have a decided influence on unity, but some figures keep their unity better than others. The comparative excellence of the above figures was found to be as follows, as is seen from Table II. The circle and cross are the best units, the monument next, the rectangle next, then the inverted triangle, and the pyramid-shaped figure the least unified.

TABLE II

	Unit	Manifold
Circle.....	27	6
Cross.....	27	6
Rectangle.....	17	15
Pyramid.....	8	24
Inverted triangle.....	15	16
Monument.....	24	7

Combinations of two colors were next tried. The same figures were used, formed of six squares as in the preceding experiment. The general result was that where colors were widely contrasting the figure would break up into two color groups. The subjects vary very much individually as to the influence of color upon their appreciation of form. The same general result as in the preceding experiment in regard to the unity of the different figures was found to hold. Only three cases of manifold were reported. The choice was usually be-

TABLE III

	Unit	Group	Manifold
Circle.....	16	18	1
Cross.....	21	14	
Rectangle.....	15	18	2
Pyramid.....	9	26	
Inverted triangle.....	18	17	
Monument.....	24	11	

tween a unit and two color groups. That there should be eleven cases of color grouping in the case of the monument where the parts were contiguous is significant for the effect of color. See Table III.

Color Opposed to Form. In the next experiment three squares and three triangles were used and combinations of two colors, the division according to color and according to form not coinciding. The object was to see whether color or form was the stronger factor in determining a group. With the time used, one-fifth second, the result proved to be that color without question attracted the attention first, and judgments were uniformly given in favor of color groups. A longer time, one-half second, was given, and the same series of figures was used again without difference in the results as to appreciation of distinction in form. Some subjects reported that they did not notice that there were different shapes used, the impression being merely spots of color.

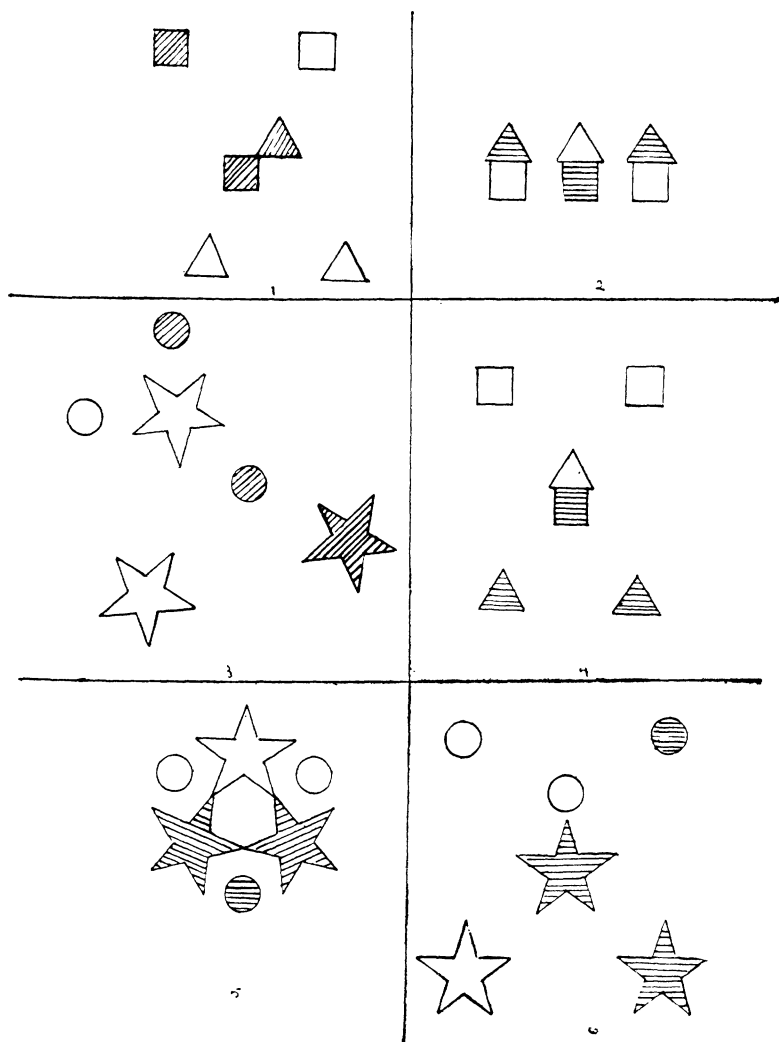
The effect of the longer time was to increase the number of units and color groups, and to decrease the number of cases of a manifold. In the first series, time one-fifth second, there were reported 51 units, 70 color groups, 16 manifold; with longer time, one-half second, there were reported 60 units, 85 color groups, 9 manifold.

As to the relative merit of the triangle and the circle the triangle was judged a unit slightly more often than the circle. In the first series the circle was reported a unit 24 times and the triangle 27 times; with the longer exposure the circle was a unit 29 times and the triangle 31 times. Contiguity proved a stronger factor than color when the arrangement was in three groups of two each. In the first series contiguity formed the group 28 times, color 10 times; with longer time, contiguity formed the group 25 times, color 13 times.

With the forms used in the preceding experiment it was found that even with long exposure the influence of color was stronger than the influence of similarity of shape. The difference between square and triangle was evidently not sufficiently great to have much effect in forming groups. In order to test the matter further a greater difference in form was sought and large stars were now combined with circles of smaller size. See Plate III.

Five figures were used: an irregular figure, called a butterfly by some of the subjects (Plate III, fig. 3), the circle, the cross, an hour-glass shape, and another irregular arrangement. Six different combinations of colors were used of varying contrast-

PLATE III.



ing power, and the arrangement of colors within the figures were varied. The combinations used were blue-yellow, violet-green, orange-red, green-yellow, red-yellow, and red-green. Time used was one-half second. For the result see Table IV.

TABLE IV.

	Unit	Form-group	Color-group	Manifold
Butterfly.....	3	10	27	2
Cross.....	22	3	17	
Circle.....	25	3	14	
Hourglass.....	14	3	22	3
Irregular.....		9	28	5
Total.....	64	28	108	10

The total number of form groups to the total of color groups is 28 to 108, which amounts to 80% of the judgments in favor of color. A decided preference thus is shown for grouping by color, notwithstanding the fact that the difference in form was made very marked.

By referring to Table IV we see that the circle is the best unit of the figures chosen, it being a unit 25 times out of a possible 42, the cross very nearly as good, a unit 22 times, the hour glass 14 times, while the irregular arrangements show no unity except that the first figure is a unit three times through association with a butterfly.

The Effect of Suggestion. A test of the relative strength of the influence of color and form of a different nature from the preceding is now introduced. Hitherto the subjects have been requested to keep their minds as free as possible from any preconceived ideas; and to maintain the attitude of passive attention throughout. At this point the influence of suggestion was made a feature of the experiment. The same material was used as heretofore; squares and triangles being combined, and stars and circles. (Plate III, figs. 3, 4, 5, 6.) Fifteen figures were arranged in which form groups and color groups were opposed. Color combinations used were the same, red-green, red-orange, red-yellow, green-violet, green-yellow, blue-yellow. The time used was one-half second. Before each exposure the subject was instructed that he would see

the figure in a particular way. At one time a form group was suggested and at another a color group, the whole number of each being the same. The form of the instruction was as follows: "You will now see two color groups, one red and one green," or "You will now see two form groups, a group of stars and a group of circles," and so on. The result of this experiment is given in Table V.

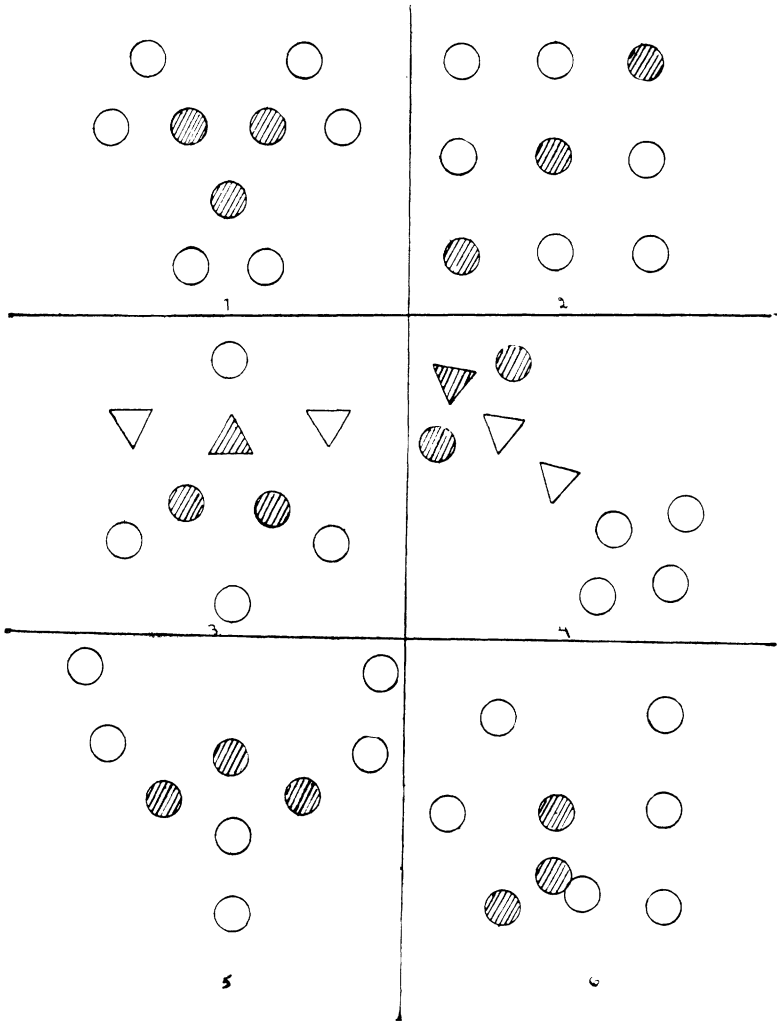
TABLE V.

	Unit	Form-group	Color-group	Manifold
Color-groups suggested. . .	6	10	89	
Form-groups suggested. . .	8	40	56	1

By studying the above table we find that when color is suggested there occur 85% of color-groups; when form is suggested the color-groups are still in the predominance, being 52% of the whole number of exposures; while when color is suggested, only 10% of the figures are seen as form-groups, and when form is suggested the number is increased only to 38%. This evidence seems quite conclusive in proving that color is a stronger unifying factor than similarity of form. A study of special figures (Plate III, figs. 4, 5) shows that some give color-groups preferably even when form-groups are suggested, while there are none to which a preference for form-groups is shown when color is suggested.

Form Opposed to Color with Increased Complexity of Material Used. A complication of the experiment was introduced by taking nine objects, variously combined into six different figures. See Plate IV. These figures were repeated on three different occasions. When presented the first time the objects were all of the same shape, circles. The next time two different forms were used, six circles and three triangles. The third time the objects used were four stars, three triangles, and two circles. On each occasion two colors were used, the division by color and the division by form not coinciding. The first figure (Plate IV, fig. 1) easily falls into three triangles, and for that reason is not so good a unit. The arrangement in a square, figure 2, proves to be the best for

PLATE IV.



holding so many parts together. The circle with inner filling, figure 3, proves to be not so good a unit as the circle unfilled, the increased complexity of the figure decreases its unified character, showing that simplicity is an essential for a good unit. In case of figure 4, though the axis of the balance is diagonal, yet it is one of the best units of the series. The holding power of the diagonal line is strong. Figure 6 is a combination of three distinct position groups. These have no connection with each other and thus the figure does not make a good unit. In the short exposure the arrangement of the three groups is hardly detected, and the judgment of a unit is given only where there is some association, as of a letter or sign. Figure 5 is one of the best units of the series, second only to the square, association with a Y helping the unity, the symmetrical arrangement also assisting. The number of judgments in favor of unity for the six figures respectively, throughout the three series of exposures, was: figure 1, 21; figure 2, 60; figure 3, 43; figure 4, 48; figure 5, 53; figure 6, 10. Therefore, arranged in order of excellence as units, we have figures 2, 5, 4, 3, 1, 6.

The effect of introducing different forms into the figures in the second and third series of exposures was to decrease the number of color groups, and to increase the number of cases of manifold. Units remain about the same notwithstanding the fact that the repetition of the figures in this way increases the chance of their being seen as a unit on account of their familiarity. The number of color groups in Series I, where circles alone were used, was 131; in Series II, where circles and triangles were used, it was 87; in Series III, where stars, circles, and triangles were used, it was 36. The number of form groups, with circles and triangles used, was 10; the number of form groups, with stars, circles, and triangles used, was 12. Thus, though the effect of introducing different forms into the figures is to decrease the number of color groups, still the total number of color groups exceeds the number of form groups. This is a confirmation of the fact already established that color is a more important factor than form in determining groups.

Direction. The next factor that makes for unity to be studied is the influence of the direction in which the component parts point. For this purpose six isosceles triangles were chosen with acute angle at apex (Plate I, fig. 5), all of the same color, gray. These were arranged in various figures, a triangle, rectangle, a V and V inverted, triangle inverted and

diamond. (Plate V.) At first, these triangles are made all to point upward, then downward, then to the right, then part up and part to the right, and finally part to the right and part to the left. This change of direction proves to have a very noticeable effect on the unity of the figure. The subjects were asked to discriminate between three degrees of unity; excellent, good and poor. The figures suffer a marked decrease in unity, according as the direction of the parts is changed. The results obtained by judgments on figure 1, Plate V, are given in Table VI. The other figures suffer a decrease in unity in like manner. The triangle with parts all pointing up (Plate V, fig. 1) is the best unit of all, all the subjects judging it an excellent unit.

TABLE VI.

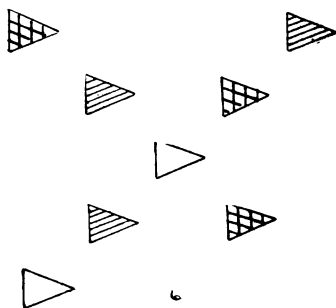
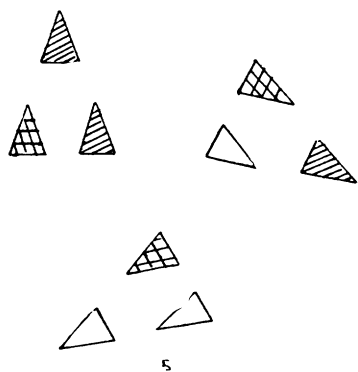
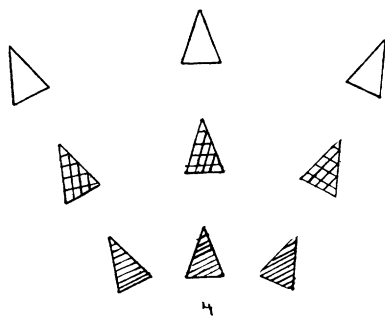
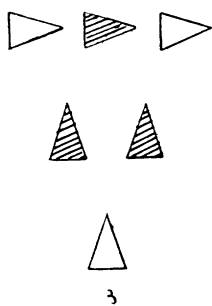
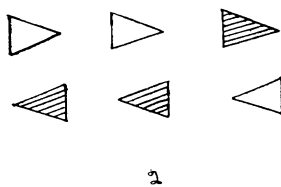
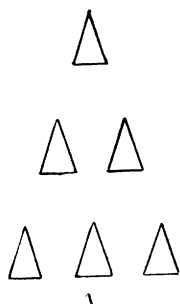
Direction of parts	Excellent	Unit Good	Poor	Groups	Manifold
Up.....	7				
Down.....	3	1	2	1	
To right.....	1	2	2	2	
3 up and.....	}	2	2	3	
3 to right.....					
3 to right.....		2	3	1	1
3 to left.....					

Color Opposed to Direction. The preceding experiment was repeated with the addition of color. The combinations of colors used were red-green, orange-violet, blue-yellow, and red-yellow, the color being evenly divided among the objects. Color in this case is the more potent influence in determining groups, the number of color groups to the number of direction groups being 57 to 13. See Table VII.

Another experiment opposing color to direction was made, using more complicated figures, nine objects and three colors. (Plate V, figs. 4, 5, 6.) The color combinations were violet-red-green, blue-yellow-red, orange-green-blue, red-yellow-violet. The number of cases of manifold were noticeably increased, confusion being caused by the change in direction of parts and the number of the colors used. The number of color groups slightly exceeded the number of direction groups, 39 to 23.

To emphasize direction another experiment was made using as material triangles tipped with an arrowhead, and diamond-

PLATE V.



shaped objects tipped with arrowheads at both ends. (Plate I, figs. 6 and 7.) Six of these objects were used, three single and three double-direction, and two colors. The color combinations were red-green, orange-violet, blue-yellow, and red-yellow. Fifteen figures were used, and were then repeated with a different arrangement of the colors. Direction thus emphasized produced more groups than color, direction groups to color groups being 100 to 68. Fewer cases of unity and more cases of a manifold occur, inasmuch as both the distraction of color and of diversity of direction were present.

In general, color and direction were found to be fairly evenly balanced factors. Groups could be arranged to favor one or the other. Much depends on position and the arrangement of the colors. Color favored by position will prevail. Likewise when direction is assisted by position, direction prevails over color, as in the case of the arrangement in lines (Plate V, fig. 4), direction groups to color groups being four to two.

TABLE VII.

	Unit			Groups		Manifold
	Good	Medium	Poor	Direction	Color	
Six triangles, two colors...	28	45	44	13	57	22
Nine triangles, three colors..	15	42	33	23	39	59
Six arrowheads two colors...		2	8	100	68	22

Size. The relative size of the objects forming a group has heretofore not been regarded, all the objects in the field of vision being the same size or nearly so. The effect of size was now made a subject for investigation in itself. For this purpose circles were chosen to prevent any influence of direction inasmuch as the circle does not guide the eye beyond itself. Three large circles and three small ones were taken, all of uniform color, gray; this being to avoid the distraction of color. The size of the circles was 17 mm. and 6 mm. in diameter, respectively. (Plate I, figs. 8 and 11.) Time used was one-fifth second. Thirty different figures were presented, some symmetrical, some lines, some triangles, and some irregular. The result was more uniform than was the case with any other factor. The subjects seemed to be affected by size

in the same way and to the same extent. The three large circles were grouped together quite regularly and the three small circles also, even in cases where position would favor another grouping. Moreover, the group of large objects usually appeared first in order of time. The total of size groups perceived out of 210 exposures was 183, units 15, position groups 6, and manifold 6; that is, 87% of all ways of apperceiving the figures exposed consisted of groups according to size. Of these there were 49 cases of perceiving one group only, in which case the group was the one composed of the large circles. In 41 cases the large group was reported as being seen first and in 15 cases it was pronounced a better group or more prominent. Only in two cases was the group of small circles pronounced better, and in each of these the central position favored it.

A second experiment with size was tried in which nine circles were used, three sizes, 25 mm., 12 mm. and 6 mm. in diameter respectively. (Plate I, figs. 12, 3, 11.) The time used was longer, one-half second. The result corroborated the result of the preceding experiment. Groups were formed according to the size of the objects, 201 cases out of a possible 210, or 90%; only 5 cases of unity were reported, 3 position groups and one manifold. There were reported 87 cases of one group only, this being the group of the largest circles; 55 cases of two groups, consisting of the large and medium sized. Quite regularly there was a difference in time of apperception of the groups, the group of large circles being seen first, medium sized next, and smallest last. When two groups were apperceived, the large ones appeared first 44 times. The order of large, medium and small was reported 60 times, and the order of large, small, medium 8 times. In the latter case the group of small circles was usually in the center or some prominent position. The order medium, large, small was recorded once.

Color Opposed to Size. The material, figures and time were the same as for the first experiment with size, with the addition of color. The combinations of color were: red-green, blue-yellow, orange-violet, red-yellow, orange-green. There was a decided tendency for the formation of size groups rather than color groups. Of 190 exposures there were 147 cases of size groups or 81%, 9 cases of unity, 3 of position groups and 21 color groups. One group only, a group of large circles, was seen 46 times; and again, when both groups were seen, the group of large circles entered consciousness first. This

was reported 56 times, while the opposite order, small first and large next, was reported once in the case where the small circles outlined an outer triangle. It might be suggested that, inasmuch as size was the new feature introduced into the experiment, that might be the reason for its proving so powerful a factor. This consideration was outweighed by the fact that the series where size was opposed to color followed upon two preceding series where color had not been used, thus making color the additional feature of the experiment; so that novelty in itself can hardly account for the preponderating influence of size. Also, inasmuch as the subjects had been giving judgments of color groups for some time, it might be argued that this, if established as a habit, would influence their judgments in this case. Whether a new feature introduced or an habitual manner of apperceiving would be the stronger influence can hardly be decided, but the results would hardly be so uniform for all the subjects in case any uncontrolled influence were at work. The subjects were more unanimous in their response to the size factor than to any other in the whole series of experiments. Their susceptibility to color influence was markedly not uniform, and seemed to be quite an individual matter.

Form Opposed to Size. The material consisted of the large and small circles 17 mm. and 6 mm. in diameter, respectively; large and small squares, sides 15 mm. and 5 mm. respectively. The color used was gray. (Plate I, figs. 8, 11, 10, 13.) These were arranged in various figures. Size groups still predominated, though the percentage, 75%, was not so large as in the previous experiments. The number of position groups was slightly increased, being 19 out of 180 exposures. Units seen numbered 15, there were two cases of manifold, while only nine cases of form groups were reported. Again we find cases of the group of large objects seen first 13 times; and when both a group of large and a group of small were seen, the order in time of large, then small, occurred 78 times; the opposite order, small first, was reported once. For the most part the subjects reported that the difference in form did not particularly attract their attention, although at times it acted as a disturbing factor. Yet in the case of two subjects the squares stood out prominently contrasted with the circles. And of the 37 cases of form groups reported (and of these only nine were first experiences), there were 22 cases of one group only seen, and that the group of squares. One case of circles only occurred. Twice the order occurred of squares first, and then circles, when both were perceived.

Combinations of Different Sizes. The question arises as to just how much of a difference in size there must be in order to produce a marked effect in forming units. The combination of circles 17 mm. and 6 mm. in diameter, respectively, was effective, the difference in diameter being 11 mm.; also that of circles 25 mm., 12 mm., and 6 mm. in diameter, respectively, with difference of 13 mm. and 6 mm. The step was next taken to make the difference in size less in order to test the extent of its importance. Circles 17 mm., 12 mm. and 9 mm. in diameter respectively were used in three combinations: circles 12 mm. and 9 mm. in diameter, with the difference of 3 mm.; circles 17 mm. and 12 mm. in diameter, with the difference of 5 mm., and circles 17 mm. and 9 mm. in diameter, with difference 8 mm. Six objects, the same time, the same figures and the same combinations of colors were used as in the case of the preceding experiment where color was opposed to size. Only four subjects were available for this experiment, but the result was the same for all of them. The first combination of circles 12 mm. and 9 mm. in diameter, with difference 3 mm., produced no size groups, the subjects reporting that the difference in size was not noticeable, and accordingly color groups predominated. When the combination of circles 17 mm. and 12 mm. in diameter was used, the subjects reported that they noticed the difference in size, but it was not great enough, evidently, to act as a unifying factor, for here again no size groups occurred, and color groups predominated. But when the combination of circles 17 mm. and 9 mm. in diameter was used, with difference of 8 mm., size groups again appeared. The smallest difference in size, when size was effective, three sizes being used, was 6 mm. A difference of 5 mm. in diameter was ineffective, while a difference of 8 mm. produced size groups. The conclusion reached is that the difference in size, under the conditions of this test, must be at least 6 mm., and preferably 8 mm. in order that size might be effective as a unifying factor. Where the difference in diameter was 11 mm. there was no question of the effect of the element of size.

Summary. I. Position:¹¹ Contiguity makes for unity.

¹¹ Stratton considers that the interest in space form is more primitive than the sense of color. By form he means what we have here called position. He speaks of the "rivalry between the sensuous and the interconnective element," and shows that one or the other is subordinated. "If the attention is occupied with the color, the form and significance are in the background."

Stratton: *Experimental Psychology and Culture*, pp. 250 and 254.

Position assists form to overcome color. Position in a line has great power. Position throws the balance in favor of color or direction. Position as an opposing factor to size forms a group. Of the geometrical figures used the triangle and circle are the best units, the diamond and square next, lines are effective, the rectangle is good and other figures in varying degrees. This estimation is merely tentative. It seems to be justified by the tests that have so far been made. It might be that other conditions would bring out different results.

II. Form: Differing forms used within the figure disturb the unity. The effect also is to interfere with color grouping, and to produce a manifold. Similarity of form may determine a group, but this is, perhaps, the weakest of the factors studied, and it proves to be weaker than color. The influence of form was found to be also weaker than size.

III. Color: Color proves to be a strong distracting influence. Color is a stronger influence than form in determining groups. It is stronger than form even when suggestion is used to assist. Color and direction are nearly equal factors. Color is weaker than size as a unit making factor.

IV. Direction: Direction is a distracting influence and is able to break a unit. The power of direction is nearly equal to that of color, and when assisted by position may be stronger than color.

V. Size: Size is the strongest factor studied, when the difference in the size of the objects is made sufficiently great. Size is stronger than position, color, and form.

Analysis of the Process of Unification. In studying the influence of these various factors in the course of the experiment, it has been possible to observe the process of unifying. This process is not the same for all. Some minds are analytic while others may be called synthetic. The subjects have shown marked individual characteristics in their method of apperceiving. For instance, one subject will serve as an example of a pronounced synthetic type of mind. He shows the tendency to see the objects as individuals at first and to report a unit as a second experience. When questioned as to this habit, he said that the parts would persist in coming first, and the unit developed later. On the other hand, another subject illustrates the opposite tendency. A unit for him was the first experience in the majority of cases. The other subjects, while not as marked in type, exhibited many individual traits. Especially their susceptibility to color varied, three being ex-

tremely sensitive to the color influence, others not so much so, and one noticeably not influenced by it. This bears out the remarks of Stratton¹² in regard to the personal equation in the matter of form and color.

The processes of analysis and synthesis noticeable in the mental operations of the above-mentioned subjects may be found, the one or the other, in almost every judgment given throughout the experiment. It has been interesting to watch the influence of the various factors at work. We might say, in general, that the process in question is either destructive or constructive. A unit is seen and then is torn in pieces, or a manifold is seen and of the elements a unit may be constructed. Often the closing shutter would interrupt the process so that it was caught, as it were, half way, and the subject would report that he saw a unit, but that it was just about to break. A "tendency to break" was a frequent comment made when the force of the factor that was being studied, color, form, as the case might be, was not quite strong enough to prevent the unit and yet its influence was evident in consciousness. It seemed almost possible to measure the destructive tendency.

In studying the influence of the various factors at work, we find the following results: When two unit making factors are opposed to each other, the result varies according to the strength of the opposing elements, and it is possible to distinguish six different degrees of the influence of what may be termed the secondary factor. For one influence is usually the stronger and may be termed the primary or predominant factor, while the other is weaker and secondary.

1. The primary factor determines the group, while the secondary, though objectively present, does not enter the threshold of consciousness. This case occurs repeatedly. Many times when color and form were opposed, the subject would not be conscious at all that different shapes were used. Also when color and size were opposed, the difference in size being purposely made very slight, the difference of 3 mm. in the diameter of the circles was not noticed, and the subjects reported that the circles seemed about the same size.

2. The primary factor determines the group, while the secondary is just noticeable but is ineffective. In cases of unity determined by arrangement of the parts in a circle, colors used were apparent to the subject, but had no effect in disturbing the unity. Also where color was opposed to size, a difference in size of 5 mm. in the diameters of the circles was

¹² Stratton: *l. c.*, p. 251.

noticed, but did not have power enough to influence the grouping.

3. The primary factor determines the group while the secondary is not only noticeable but has a decided effect. It may have a destructive tendency. Its effect is to act as a disturbing element, though it has not power enough to break the unit. Many cases occur where color is reported as a disturbing element. Direction was felt to be disturbing many times, for instance, in the case of Plate V, figure 3, a medium unit was reported, but the effect of motion due to the direction was felt.

4. The effect of the secondary factor is constructive. The primary factor determines the group while the secondary draws into it an additional element. There are many cases of this constructive influence, for example, the case where large circles form the group while a small red circle was drawn in through the influence of color. The very act of including the additional element was seen in process in one case. The large circles made the group while a tendency to include a small orange circle was felt, but the process was not completed. Three circles made a group determined by form, while a large square was added because of its size.

5. The factors may be evenly balanced in power and as a result cases of fluctuations or rivalry occur. In these cases of rivalry one or the other of the forces may win out and determine which group is to be apperceived; or a confusion arises, neither winning, and a manifold is then reported. Cases of rivalry between form and color occur, as in the case of Plate III, figure 3, and many others. Sometimes color wins out, sometimes the fluctuation persists and sometimes confusion results. There are cases of rivalry between direction and color, as Plate V, figs. 4, 6. In the case of Plate V, fig. 6, the conflict results in a manifold. In one case the process of grouping by color was actually interrupted by a sudden perception of direction groups. A size group and a position group were seen, while the rival tendencies of size and color produced a disagreeable feeling tone.

6. The primary factor determines the group when the power of the secondary factor suddenly increases, acts destructively, and causes confusion and a manifold results. A number of cases occurred where a unit was reported as a first experience and a manifold as a second. This shows just such an operation as described. The influence of color is often found to act in this way. A poor unit was reported as a first experience, then two groups as a second, and finally the disintegra-

tion was completed and a manifold was the result. The feeling of confusion often accompanied such an experience.

The data upon which these results have been based are too few to permit final conclusions upon all the points involved, but they have been presented for the suggestions they offer and should prove of value not only for theoretical aesthetics, but also for practical purposes especially in the fine arts, decorative art, and advertising.